CHAPTER 13

INFANT AND CHILD MORTALITY

This chapter presents survey-based estimates of infant and early childhood mortality for eight countries: four in Eastern Europe and the Caucasus (Romania, Armenia, Azerbaijan, and Georgia) and four in Central Asia (Kazakhstan, the Kyrgyz Republic, Uzbekistan, and Turkmenistan). Survey-based mortality data are a new resource for documenting mortality levels in these countries.

There is general consensus among demographers that government infant mortality rates for these countries are underestimated and a number of studies have provided mortality estimates that exceed government rates.[1] Those studies have relied on published mortality data from government registration systems, identified defects in those data and employed modeling techniques to re-estimate mortality rates. In contrast, the mortality estimates provided in this chapter are based solely on survey data and are fully independent of government published data. As shown below, the survey-based infant mortality estimates always exceed government rates-frequently by a factor of two or more.

The chapter begins with a discussion of the differences between the definitions of live birth and infant death used by the former Soviet Union and by the World Health Organization (WHO). Section 2 describes survey procedures used to collect data on live births and their survivorship. Sections 3 and 4 provide the survey-based estimates of infant and child mortality and compare those estimates to published government rates. Section 5 evaluates the quality of the survey data.

[1] For example see: Anderson BA and Silver BD, 1986 and 1997; Ksenofontova N, 1994; Velkoff VA and Miller JE, 1995;Kingkade WW and Sawyer CC, 2001.

Section 6 shows mortality differentials and Section 7 tracks the trend of infant mortality for a recent period preceding each survey. The chapter concludes with a summary of findings.

13.1 Definitional Issues

There are significant differences in the definitions of live birth and infant death between countries using criteria established by the former Soviet Union and those recommended by the WHO. All the countries considered in this report used the Soviet definition of live birth and infant death prior to the collapse of the Soviet Union and, with the exception of Armenia, all continue to do so at present. Armenia formally changed to the WHO definitions in 1995, although it is not clear that those definitions are being widely implemented in Armenia (GOA, UNICEF, and SCF, 1999).

The WHO recommended definitions of live birth and infant death are relatively simple. Live birth is defined as a product of conception, irrespective of the duration of the pregnancy, which after separation from the mother, showed any sign of life (i.e., breathing, beating of the heart, or movement of voluntary muscles). An infant death is defined as the death of a child less than 1 year of age (WHO, 1993).

The Soviet definitions of these events differs from the WHO definitions both for preterm and for full term pregnancy terminations (Notzon FC, et. al., 1999). Preterm pregnancy terminations (those weighing less than 1,000 grams, less than 28 weeks gestation or less than 35 centimeters long) are classified as miscarriages, unless the child survives for 7 days. Full term pregnancy terminations (pregnancies with a gestation age of 28 weeks or longer) are classified as stillbirths unless breathing is evident at delivery.

These definitional differences mean that fewer pregnancy outcomes with a low survival probability will be classified as live births according to the Soviet definitions than according to the WHO definitions. It follows that mortality rates, especially early neonatal mortality rates (rates for less than 7 days) will be lower under the Soviet definitions than under the WHO definitions. However, if properly implemented, the two classification systems should only result in different rates for the early neonatal period and rates inclusive of that period (neonatal, infant and under-5 mortality rates). Postneonatal mortality and child mortality rates (exact ages 1 to 5) should not be affected by these definitional issues.

13.2 Data Collection Procedures

The objective of the surveys was to collect information on live births and their survival status according to the definitions recommended by WHO. When collecting mortality data from survey respondents, care must be taken to ensure that the respondents are clear about the events that they are to report. This is particularly important when collecting infant mortality data in a country where the definition of live birth used by the civil registration system and the medical community differs from that used in the survey. With the exception of Armenia, that was the situation in the other countries of the region at the time the surveys were conducted.

A full description of the survey procedures for collecting birth and child death data is given in the Appendix to this chapter. Here we only summarize the procedure used to convey to respondents which events that they were to report as live births. Although it differed in some surveys, an identical procedure was used in the majority of surveys. The procedure consisted of direct questions about the number

of deceased children to which a women had given birth and the use of probing questions if she reported no deceased children. First, the question was asked, "Have you ever given birth to a boy or girl who was born alive and later died?" If the response was affirmative, the respondent was asked "How many boys and how many girls have died?" If the response was negative, a probing question was asked "Any baby who cried or showed signs of life but survived only a few hours or days?" These questions are consistent with the WHO definition of live birth and, judging by the neonatal and infant mortality rates computed from the survey data, they seem to have worked fairly well.[2]

Following the above questions, pregnancy history data were collected on an event-by-event basis. For each live birth reported in the pregnancy history, information was collected on the date of birth (month and year), sex, survival status, and current age (for surviving children) or age at death (for deceased children). These data are used for the direct calculation of mortality rates for the following age intervals:

- **Neonatal mortality (NN)**: the probability of dying within the first month of life.
- **Postneonatal mortality (PNN)**: the difference between infant and neonatal mortality.
- **Infant mortality (IMR)**: the probability of dying between birth and exact age 1.
- **Child mortality (Child)**: the probability of dying between exact ages of 1 and 5.
- **Under-5 mortality (Under-5)**: the probability of dying between birth and exact age 5.

13.3 Survey Estimates of Infant and Child Mortality

Table 13.3 shows infant and child mortality estimates from the surveys. Rates are shown for a 5-year retrospective period in order to keep sampling variability at a manageable level. The infant mortality estimate was lowest for Romania and Georgia (32 and 36 deaths per 1,000 live births), progressively higher for Georgia, and Uzbekistan (42,and 49 per 1,000) and substantially higher for Azerbaijan, Kazakhstan, the Kyrgyz Republic, and Turkmenistan (74, 62, 61, and 74 per 1,000). In terms of under-5 mortality, the countries fall in the same rank order– Romania had the lowest rate (35 per 1,000 live births) and Azerbaijan and Turkmenistan, the highest rates (88 and 94 per 1,000).

These mortality estimates are much higher than was expected prior to the implementation of the surveys and they raise the long standing issue concerning the extent to which the government reported infant mortality rates are underestimated.

13.4 Survey and Government Mortality Rates Compared

Table 13.4.1 shows survey mortality estimates for the 5-year period preceding each survey and mortality rates from government sources for the same time period. The survey estimates of infant mortality exceed the government rates by about 50% for Romania, Georgia, and Uzbekistan and are more than twice as high for Armenia, Kazakhstan, Kyrgyzstan, and

[2] However, it should be pointed out that the series of questions is not fully satisfactory because the probing question was not asked to all women. It is quite possible that a woman who reported one child death in response to the first question could have had an additional live birth that died soon after childbirth but was not appropriately reported as a consequence of not receiving the probing question.

Table 13.3
Survey Infant and Child Mortality Estimates
(Five-Year Period Preceding the Survey)
Eastern Europe and Eurasia: A Comparative Report

Region and Country	Time Period	Mortality Rates (per 1,000)*					Ratio: Neonatal Mortality Rate/ Infant Mortality Rate
		Neonatal	Postneonatal	Infant	Child	Under-5	
Eastern Europe							
Romania, 1999	1995–1999	20.6	10.9	31.5	3.6	35.0	0.65
Caucasus							
Armenia, 2000	1996–2000	19.5	16.7	36.1	3.0	39.0	0.54
Azerbaijan, 2001	1996–2000	34.1	40.3	74.4	14.0	88.4	0.46
Georgia, 1999	1995–1999	25.3	16.2	41.6	3.8	45.3	0.61
Central Asia							
Kazakhstan, 1999	1995–1999	33.6	28.3	61.9	10.1	71.4	0.54
Kyrgyz Rep., 1997	1993–1997	31.6	29.7	61.3	11.7	72.3	0.52
Turkmenistan, 2000	1996–2000	33.8	40.1	73.9	22.0	94.3	0.46
Uzbekistan, 1996	1992–1996	22.8	26.3	49.1	10.7	59.3	0.46

* Neonatal, postneonatal, infant and under-5 mortality rates are per 1,000 live births. Child mortality rates are per 1,000 children surviving to age 1.

Turkmenistan. The survey rate of infant mortality for Azerbaijan is more than four times the government rate. Figure 13.4 displays the difference between the survey estimates of infant mortality and the government rates.

In almost every country, the survey estimates for both the neonatal and the postneonatal components of infant mortality exceed government rates. In the case of neonatal mortality, the survey estimates substantially exceed the government rates–always at least twice as high. No doubt, some portion of the neonatal differences is due to the definitional issues discussed earlier. However, the survey estimates of postneonatal mortality exceed the government rates in all but one country–typically by more than 50%. (In the case of Romania, postneonatal mortality rates from the two sources are essentially the same: 11 and 12 deaths per 1,000 live births). The finding of higher postneonatal mortality rates from the surveys is important because it can not be explained by differences in the definition of a live birth. The most probable explanation is that there is underreporting of postneonatal deaths in the government registration systems–and that raises the possibility that there is also underreporting of neonatal deaths in the government systems.

The survey estimates of child mortality (mortality between exact ages of 1 and 5) and from government sources tend to be similar. In six of the eight countries, the absolute differences are 1 or 2 points per 1,000 live births. In two countries, the differences are larger– about 6 points per 1,000 in both Turkmenistan and Uzbekistan. The direction of the differences is interesting. In both cases, the survey estimates are less than the government rates (22 versus 28 deaths per 1,000 live births for Turkmenistan and 11 versus 16 per 1,000 for Uzbekistan).

Under-5 mortality rates are also shown in Table 13.4.1. The survey estimates exceed official rates by between 30% (Uzbekistan) and 190%(Azerbaijan).

The survey estimates of mortality rates are based on the number of births reported by a sample of female respondents and are subject to sampling error. Table 13.4.2 shows the

Table 13.4.1
Comparison of Survey Infant and Child Mortality Rates and Government Rates
(Five-Year Period Preceding the Survey)
Eastern Europe and Eurasia: A Comparative Report

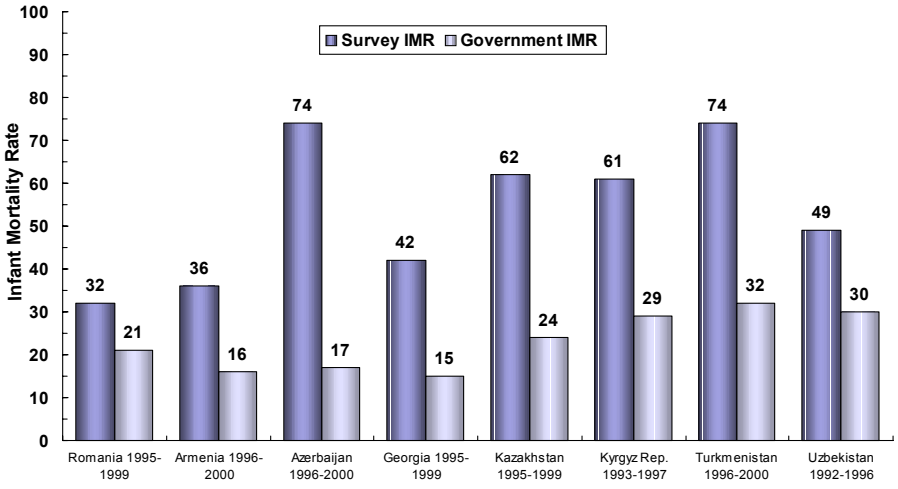
Region and Country	Source	Mortality Rates (per 1,000)*				
		Neonatal	Postneonatal	Infant	Child	Under-5
Eastern Europe						
Romania, 1999	Survey rates	20.6	10.9	31.5	3.6	35.0
	Government rates	9.0	11.9	20.9	4.5	25.3
	Ratio	2.3	0.9	1.5	0.8	1.4
Caucasus						
Armenia, 2000	Survey rates	19.5	16.7	36.1	3.0	39.0
	Government rates	9.1	8.5	16.3	2.1	18.4
	Ratio	2.1	2.0	2.2	1.4	2.1
Azerbaijan, 2001	Survey rates	34.1	40.3	74.4	14.0	88.4
	Government rates	3.7	13.6	17.2	12.9	30.1
	Ratio	9.2	3.0	4.3	1.1	2.9
Georgia, 1999	Survey rates	25.4	16.2	41.6	3.8	45.3
	Government rates	11.0	4.1	15.1	3.9	18.9
	Ratio	2.3	4.0	2.8	1.0	2.4
Central Asia						
Kazakhstan, 1999	Survey rates	33.6	28.3	61.9	10.1	71.4
	Government rates	11.8	12.6	24.3	7.7	31.8
	Ratio	2.8	2.2	2.5	1.3	2.2
Kyrgyz Rep., 1997	Survey rates	31.6	29.7	61.3	11.7	72.3
	Government rates	9.7	19.2	29.3	12.6	41.5
	Ratio	3.3	1.5	2.1	0.9	1.7
Turkmenistan, 2000	Survey rates	33.8	40.1	73.9	22.0	94.3
	Government rates	8.6	23.3	31.9	27.6	58.6
	Ratio	3.9	1.7	2.3	0.8	1.6
Uzbekistan, 1996	Survey rates	22.8	26.3	49.1	10.7	59.3
	Government rates	9.3	21.2	30.1	16.3	45.9
	Ratio	2.5	1.2	1.6	0.7	1.3

* Neonatal, postneonatal, infant and under-5 mortality rates are per 1,000 live births. Child mortality rates are per 1,000 children surviving to age 1.
Sources: Survey rates; Country reports, Reproductive Health Surveys and Demographic Health Surveys.
Government rates; European Health for All database. WHO Regional Office for Europe, Copenhagen, Denmark (www.euro.who.int/FADB).

survey estimates of infant mortality, their sampling error and 95% confidence interval, as well as government infant mortality rates. With the exception of Romania, the government infant mortality rates are less than the lower boundary of the confidence interval for the survey estimate–implying that sampling variability can not account for the differences in the rates. In the case of Romania, the government rate is only marginally greater than the lower boundary of the 95% confidence interval, so that, again, it is unlikely that sampling error accounts for all of the difference between the survey and the government rate.

An advantage of the comparative analysis approach used in this report is evident from these findings. The consistency of the higher survey infant mortality estimates across all countries makes the finding for each individual country credible. The cumulative weight of these findings leaves no doubt that when infant mortality is measured according to the

Figure 13.4
Survey Estimates and Government Rates of Infant Mortality*
Eastern Europe and Eurasia: A Comparative Report



*Infant Mortality Rates are per 1,000 live births.
Data Sources: Survey rates are from Reproductive Health Surveys and Demographic and Health Surveys. Government rates are from European health for all database. WHO Regional Office for Europe. Copenhagen, Denmark (www.euro.who.int/HFADB).

WHO recommended definitions, the rates are substantially higher than the reported government rates.

The finding of higher infant mortality from the surveys does not necessarily mean that the government rates are erroneous. It is possible that both sets of rates are valid given the different definitions of live birth. However, the completeness with which infant deaths are tabulated in the government registration systems, independent of the definitional issues, is being increasingly questioned, persuasively so by two studies soon to be published (Aleshina N and Redmond G, forthcoming; Wuhib T, et al., forthcoming).

The source of the differences between infant mortality rates was further investigated by determining the extent to which they arise from the early neonatal period of infancy (i.e., less than 7 days) or from the rest of infancy (i.e., day 7 to 1 year of age). Based on government reported rates (WHO, 2003) and rates calculated from the surveys, the necessary calculations were made for Armenia, Georgia, and Kazakhstan.[3] In each case, the major part of the difference was due to survey rates that exceeded government rates for the period unaffected by definitional issues (day 7 to 1 year of age): Armenia (59%), Georgia (60%), and Kazakhstan (65%). This is compelling evidence that the major part of the

[3] The contribution of the age interval from day 7 to 1 year of age to the overall difference between the survey-based and government reported infant mortality rates was computed as:

$$(Q^{S}_{7\text{-}365} - Q^{G}_{7\text{-}365}) \;/\; (IMR^{S} - IMR^{G})$$

where $Q_{7\text{-}365}$ is the probability of dying between day 7 and 1 year of age, and the superscripts S and G represent survey and government rates, respectively.

shortfall in the government rates is due to incomplete capture of infant deaths, independent of definitional issues.

Armenia, which changed from the Soviet to the WHO definition of live birth in 1995, offers an opportunity to review the impact of that change on early neonatal and overall infant mortality. The government rates of early neonatal mortality increased between 1995 (7.4 deaths per 1,000 live births) and 1996 (10.2 per 1,000) and remained at that new level through 2000 (10.7 per 1,000). However, the increase in the early neonatal mortality rate had a minimal impact on the government infant mortality rates (14.2, 15.5, and 15.7 per 1,000 for 1995, 1996, and 2000, respectively) (WHO, 2003). These rates are well below the survey estimate of infant mortality for 1996-2000 (36 per 1,000). The modest impact on government infant mortality rates is not surprising since time and effort are required to fully implement the new definitions and since there is probably underreporting of events in the civil registration system unrelated to the definition of a live birth. However, a significant implication can be drawn from the Armenia experience. If, in Armenia and in the other countries of the region, mortality rates for infancy and its components are to be monitored in the future it will be necessary to do so by using population-based surveys.

13.5 Evaluation of Survey Data

The most satisfactory procedure for evaluating the quality of survey-based mortality estimates is by comparison with mortality rates of known accuracy. Lacking such a standard, an alternative procedure involves examining the internal consistency of the estimated rates. Typically, when survey data are defective it is due to underreporting of births and infant deaths especially when the death occurred in early infancy and when the birth and death of the child occurred many years before the survey date. Significant underreporting of this kind will result in a distortion of the observed age pattern of mortality with too few deaths reported in early infancy. The ratio of neonatal

Table 13.4.2
Survey Infant Mortality Estimates with Sampling Errors and Government Rates*
(Five-Year Period Preceding the Survey)
Eastern Europe and Eurasia: A Comparative Report

	Survey Infant Mortality Estimates			Government Source	Ratio:
Region and Country	Infant Mortality Rate	Standard Error	95% Confidence Interval	Infant Mortality Rate	Survey Estimate/ Government Rate
Eastern Europe					
Romania, 1999	31.5	6.0	19.5---43.5	20.9	1.5
Caucasus					
Armenia, 2000	36.1	5.4	25.3---47.0	16.3	2.2
Azerbaijan, 2001	74.4	6.4	61.6---87.2	17.2	4.3
Georgia, 1999	41.6	5.6	30.4---52.8	24.3	1.7
Central Asia					
Kazakhstan, 1999	61.9	8.3	45.3---78.5	24.3	2.5
Kyrgyz Rep., 1997	61.3	7.2	47.0---75.7	29.3	2.1
Turkmenistan, 2000	73.9	5.4	63.2---84.7	31.9	2.3
Uzbekistan, 1996	49.1	6.6	35.9---62.4	30.1	1.6

* Infant mortality rates are per 1,000 live births.
Sources: Survey rates; Country reports, Reproductive Health Surveys and Demographic Health Surveys.
Government rates; European Health for All database. WHO Regional Office for Europe, Copenhagen, Denmark (www.euro.who.int/FADB).

to infant mortality is employed here as a test of data quality. Values of this ratio substantially lower than international experience for countries that use the WHO recommended definitions of live birth and infant death will be taken as an indication of underreporting of early infant deaths.[4]

The value of the ratio of neonatal to infant mortality (NN/IMR) can vary depending on factors such as environmental conditions, availability and access to health services, the quality of those services, etc. Improvement in these factors lowers infant mortality levels and generally lowers mortality in later infancy, as infectious diseases are brought under control, more than in early infancy, where mortality from prematurity and congenital malformations is more resistant to decline. Thus, the expected value of the ratio of neonatal to infant mortality varies with the level of mortality, being greater at lower mortality levels. At a level of infant mortality of around 40 to 60 deaths per 1,000 live births, in countries known to have relative complete reporting of events, about half of all infant deaths occur in the neonatal period. A value of 0.50 for the neonatal/infant mortality ratio will be employed as a standard for detecting significant underreporting of early infant deaths in the surveys. Because of possible variability of this ratio between populations and the sampling variability of the survey rates, only a significant departure from this value can be taken as persuasive evidence of event underreporting in the surveys.

The neonatal/infant mortality ratios for each survey were shown in the last column of Table 13.3. All values of this ratio are close to or above 0.50. The test does not indicate severe underreporting of neonatal deaths in any of the surveys. This is reassuring, although it does not establish that there was complete and accurate reporting of mortality data in the surveys.

13.6 Mortality Differentials

This section considers neonatal, postneonatal and infant mortality rates by socioeconomic and demographic characteristics of respondents.[5] The purpose is to identify population groups that are at a high risk of mortality and that would benefit from increased health and social services.

Urban/Rural Residence

Table 13.6.1 shows urban/rural mortality rates. Romania is the only country where urban infant mortality rates exceed rural rates–by about 30% (32 deaths per 1,000 live births as opposed to 27 per 1,000). In all other countries, the rural rates exceed urban rates. However, the excess of rural over urban infant mortality varies; it is small in the case of Azerbaijan, Georgia, and Uzbekistan (rural rates are higher by 10% or less) while it is much larger in the case of Armenia, Kazakhstan, the Kyrgyz Republic, and Turkmenistan (rural rates higher by between 30% and 50%).

[4] The focus of the data quality evaluation is on the main problem associated with mortality data collected by surveys: the underreporting of events. It should be clear that while an abnormally low value of the NN/IMR ratio is suggestive of underreporting of neonatal mortality, the absence of such a finding does not establish that events are comletely reported.

[5] Differentials are not shown for child mortality because of the relatively low mortality rates between exact ages 1 and 5. Differentials for infant mortality are based on events occurring in the 10-year period preceding the survey so that sufficient observations are available by variable subcategory.

A recent study of infant mortality differentials involving 20 countries found that, on average, rural rates exceed urban rates by 40% (Bicego G and Ahmad OB, 1996). The pattern of the differentials for Romania, Azerbaijan, Georgia, and Uzbekistan differs from the pattern described by Bicego and Ahmad. Although this departure may be real, it is also possible that reporting of infant deaths was less complete in rural than in urban areas, perhaps related to some characteristic of respondents such as their level of education or the higher proportion of home deliveries in the rural areas.

The distinction is important because, based on the observed rates for Romania, Azerbaijan, Georgia, and Uzbekistan, the rural mortality disadvantage is not substantial and does not imply a need for a special effort to improve rural health services. Some insight can be obtained by considering neonatal mortality rates. As indicated earlier, when there is underreporting of infant deaths in a survey, typically it is most pronounced in the neonatal period. In each of the above-mentioned countries, neonatal mortality is lower in rural than in urban areas and those differences tend to offset higher postneonatal mortality rates in the rural than in the urban areas. But, relatively low neonatal mortality in the rural areas seems unlikely because it is known that rural women have less access to antenatal and delivery care than urban women and when they do, the quality of care tends to be less adequate (see also Chapter 8). These considerations suggest the possibility of underreporting of events in the rural areas. If that was the case, the survey data in these countries underestimated both rural and overall infant mortality rates.

Mother's Education

Table 13.6.2 shows infant mortality rates by mother's education. With the exception of Uzbekistan, infant mortality rates show a consistent inverse relation with mother's education; the higher the level of education, the lower the infant mortality rate. The differentials are substantial in five of the eight countries; infant mortality among children born to women with a primary/secondary education exceeds that of children born to women with a postsecondary education by more than 60%.

Postneonatal mortality rates also show a very pronounced inverse relation with mother's education. The same is not true in the case of neonatal mortality. For example, the neonatal mortality rate for the children of the least educated women in Romania (14 deaths per 1,000 live births) is substantially less than among children of the most educated women (20 per 1,000). The education-specific rates for Uzbekistan show the same pattern. This pattern is unlikely and suggest the possibility of underreporting of early infant deaths among less educated respondents.

Sex of the Child

Table 13.6.3 shows infant mortality rates by sex of the child, mother's age at the time of birth and length of the preceding birth interval. Male rates of infant mortality are greater than female rates in every survey, with the excess the male mortality varying from a low of 10% for Armenia to a high of 50% for Georgia.

Maternal Age

Infant mortality rates are shown for three categories of mother's age. Mortality is lowest among children of mothers age 20-29, the prime ages of childbearing. Relative to those mortality rates, the excess infant mortality for children born to women under age 20 varies from 10% in Georgia to 60% in Kazakhstan. Similarly, in the majority of countries, there is excess mortality for births to women age 30 and older.

Table 13.6.1
Survey Infant Mortality Rates by Residence
(Ten-Year Period Preceding the Survey)
Eastern Europe and Eurasia: A Comparative Report

Region and Country	Mortality Rates (per 1,000)*			Risk Ratio Reference: Urban		
	Neonatal	Postneonatal	Infant	Neonatal	Postenonatal	Infant
Eastern Europe						
Romania, 1999						
Urban	24.0	8.2	32.2	1.0	1.0	1.0
Rural	14.1	13.1	27.2	0.6	1.6	0.8
Caucasus						
Armenia, 2000						
Urban	23.1	12.8	35.9	1.0	1.0	1.0
Rural	29.5	23.3	52.7	1.3	1.8	1.5
Azerbaijan, 2001						
Urban	44.4	35.0	79.4	1.0	1.0	1.0
Rural	31.3	51.2	82.5	0.7	1.5	1.0
Georgia, 1999						
Urban	26.4	10.5	36.9	1.0	1.0	1.0
Rural	21.2	20.3	41.5	0.8	1.9	1.1
Central Asia						
Kazakhstan, 1999						
Urban	25.5	18.2	43.7	1.0	1.0	1.0
Rural	30.7	33.0	63.8	1.2	1.8	1.5
Kyrgyz Rep., 1997						
Urban	29.4	25.0	54.3	1.0	1.0	1.0
Rural	34.4	36.0	70.4	1.2	1.4	1.3
Turkmenistan, 2000						
Urban	32.2	27.9	60.1	1.0	1.0	1.0
Rural	33.4	46.5	79.9	1.0	1.7	1.3
Uzbekistan, 1996						
Urban	23.5	19.4	42.9	1.0	1.0	1.0
Rural	20.9	22.9	43.8	0.9	1.2	1.0

* Neonatal, postneonatal, infant and under-5 mortality rates are per 1,000 live births. Child mortality rates are per 1,000 children surviving to age 1.

Preceding Birth Interval

Studies in many countries have found that the length of the preceding birth interval is strongly associated with infant mortality risks; births occurring after a short birth interval (i.e., less than 24 months) having substantially higher mortality than births occurring after a longer interval (Hobcraft JN, et al., 1985). Results from the surveys are consistent with these studies.

Table 13.6.3 shows infant mortality rates for second and higher order births by length of the preceding birth interval. In every country, births occurring within a birth interval of less than 24 months are at a higher risk of infant mortality than births occurring after an interval of 24 7 months. The excess mortality associated with a short birth is more than 40% in Georgia, Turkmenistan, and Uzbekistan and more than 80% in Romania, Kazakhstan, and the Kyrgyz Republic. Armenia is the only

Table 13.6.2
Survey Infant Mortality Rates by Education*
(Ten-Year Period Preceding the Survey)
Eastern Europe and Eurasia: A Comparative Report

Region and Country	Mortality Rates (per 1,000)†			Risk Ratio Reference: Postsecondary‡		
	Neonatal	Postneonatal	Infant	Neonatal	Postenonatal	Infant
Eastern Europe						
Romania, 1999‡						
Primary or less	14.3	25.4	39.7	0.7	1.3	1.8
Secondary Incomplete	20.3	11.3	31.6	1.0	0.6	1.4
Secondary Complete & Higher	19.9	2.5	22.3	1.0	1.0	1.0
Caucasus						
Armenia, 2000						
Primary/Secondary	31.1	23.7	54.8	1.8	5.6	2.6
Technicum	23.9	16.5	40.4	1.4	3.9	1.9
Postsecondary	17.1	4.2	21.3	1.0	1.0	1.0
Azerbaijan, 2001						
Primary/Secondary	38.1	52.7	90.8	1.2	6.5	2.3
Technicum	41.8	22.4	64.1	1.3	2.8	1.6
Postsecondary	31.9	8.1	40.0	1.0	1.0	1.0
Georgia, 1999						
Primary/Secondary	24.8	23.7	48.5	1.0	3.3	1.6
Technicum	26.2	11.5	37.7	1.1	1.6	1.2
Postsecondary	24.1	7.1	31.2	1.0	1.0	1.0
Central Asia						
Kazakhstan, 1999						
Primary/Secondary	28.0	29.0	57.0	1.1	1.3	1.2
Technicum	30.2	26.0	56.2	1.2	1.2	1.2
Postsecondary	24.8	22.3	47.1	1.0	1.0	1.0
Kyrgyz Rep., 1997						
Primary/Secondary	38.7	42.9	81.7	2.1	1.5	1.7
Technicum	30.5	19.5	50.1	1.7	0.7	1.1
Postsecondary	18.4	29.0	47.5	1.0	1.0	1.0
Turkmenistan, 2000						
Primary/Secondary	33.3	44.5	77.8	0.7	2.9	1.3
Technicum	28.4	30.2	58.6	0.6	2.0	1.0
Postsecondary	(45.9)	(15.2)	(61.2)	1.0	1.0	1.0
Uzbekistan, 1996						
Primary/Secondary	21.9	23.5	45.4	0.6	1.4	0.9
Technicum	16.8	19.3	36.1	0.5	1.1	0.7
Postsecondary	34.2	16.8	51.0	1.0	1.0	1.0

* Figures in parentheses are based on between 250 and 499 unwighted births.
† Neonatal, postneonatal and infant mortality rates are per 1,000 live births.
‡ In the case of Romania, the reference population is "secondary complete and higher".

Table 13.6.3
Survey Infant Mortality Rates per 1,000 Live Births by Demographic Characteristics*
(Ten-Year Period Preceding the Survey)
Eastern Europe and Eurasia: A Comparative Report

	Eastern Europe	Caucasus			Central Asia			
	Romania	Armenia	Azerbaijan	Georgia	Kazakhstan	Kyrgyz Rep.	Turkmenistan	Uzbekistan
Characteristic	1999	2000	2001	1999	1999	1997	2000	1996
Sex of Child								
Male	32.1	46.1	83.6	48.3	62.0	71.9	83.0	50.2
Female	26.3	41.9	77.8	31.5	47.3	60.2	59.7	36.7
Age of Mother								
Under 20	33.8	49.5	66.4	44.5	(79.5)	(98.1)	86.5	(45.0)
20–29	24.4	37.0	79.6	39.0	50.9	66.5	69.7	41.9
30 and older	52.0	69.0	93.8	41.9	50.3	48.0	73.3	46.1
Length of								
First Birth	24.1	32.3	76.6	36.3	51.0	73.0	67.0	41.9
Under 2 years	41.8	55.6	U	52.8	82.6	87.1	94.2	50.8
2–3 years	21.8	50.1	U	43.2	45.8	48.0	63.9	35.4
4 years and longer	46.0	44.5	U	32.5	40.1	50.5	49.0	47.5

* Figures in parentheses are based on between 250 and 499 unwighted births.
U = Unavailable

country where the excess mortality of a short birth interval is less pronounced, about 10%.

Approximately one-third of all second and higher order births in the surveyed countries occur within a birth interval of less than 24 months. This indicates a continuing need for education programs promoting the benefits of improved child spacing in addition to greater availability of reliable, temporary methods of contraception.

13.7 Time Trends in Mortality

Table 13.7 shows survey estimates of infant and child mortality rates for three 5-year periods preceding each survey.[6] Our discussion will focus primarily on infant mortality estimates. There is essentially no difference in the two mortality estimates for Romania (28 and 32 deaths per 1,000 live births for consecutive time periods) or for Georgia (40 and 42 per 1,000) and no indication of a trend in mortality. Kazakhstan and Uzbekistan both show a U-shaped pattern in the series of three infant mortality estimates. However, the series of estimates in both Kazakhstan (55, 50, and 62 per 1,000) and Uzbekistan (46, 38, and 49 per 1,000) are within the 95% confidence interval of the most recent estimate (45 to 78 per 1,000 for Kazakhstan and 36 to 62 per 1,000 for Uzbekistan [Table 13.4.2]). Thus, based on the survey estimates, firm conclusions can not be made concerning recent mortality trends in those countries.

In Armenia, Azerbaijan, the Kyrgyz Republic and Turkmenistan, the evidence for a recent decline in infant mortality is stronger (Figure 13.8). The estimates for Armenia increase

[6] For Romania, Azerbaijan, and Georgia, mortality rates are shown for only two 5-year time periods. This was necessary because the oldest women interviewed in those survey were age 44, so that for time periods more than 10 years before the survey there are no observations for births to women older than 35. Thus, mortality rates for time periods more than 10 years before the survey are not comparable to the rates for more recent time periods and are not shown.

between 1986-1990 (46 deaths per 1,000 live births) and 1991-1995 (51 per 1,000) and decline in 1996-2000 (36 per 1,000). The credibility of this trend is supported by the sharp deterioration of economic circumstances in Armenia following the breakup of the Soviet Union in 1991 and the ensuing hostilities with Azerbaijan, a conflict that disrupted Armenia's supply of oil and resulted in a sharp curtailment of electricity throughout the country.

In Azerbaijan, the Kyrgyz Republic, and Turkmenistan, the trend of infant mortality estimates is also declining. The strongest trend is in the Kyrgyz Republic where the estimates decline from 82 deaths per 1,000 live births (1982-1987) to 61 per 1,000 (1992-1997). This decline is further supported by decline in the child mortality rates (from 19 to 12 per 1,000 over the same period). The declines in infant mortality are less pronounced in Azerbaijan and Turkmenistan than in the Kyrgyz Republic and child mortality rates are essentially flat in both countries and do not particularly suggest a declining trend in mortality. Nevertheless, the survey results are, in a statistical sense, the "best estimates" of infant mortality and in all three countries they indicate mortality declines between the earliest and the most recent time period.

Table 13.7
Time Trends in Infant and Child Mortality Estimates
(Ten- and Fifteen-Year Periods Preceding the Survey)*
Eastern Europe and Eurasia: A Comparative Report

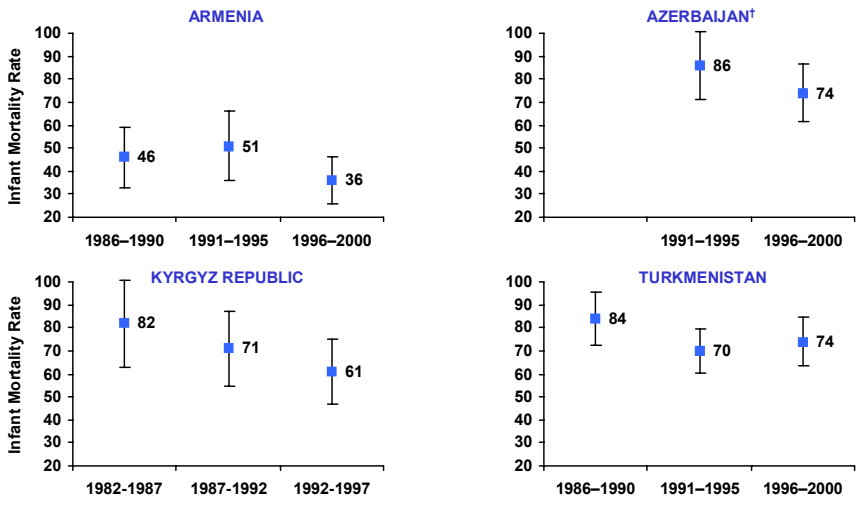
Region and Country	Time Period	Mortality Rates (per 1,000)†				
		Neonatal	Postneonatal	Infant	Child	Under-5
Eastern Europe						
Romania, 1999	1994–1999	20.6	10.9	31.5	3.6	35.0
	1989–1994	17.5	10.5	28.0	2.3	30.2
Caucasus						
Armenia, 2000	1996–2000	19.5	16.7	36.1	3.0	39.0
	1991–1995	31.6	18.9	50.5	4.7	55.0
	1986–1990	24.6	20.9	45.6	5.8	51.1
Azerbaijan, 2001	1996–2000	34.1	40.3	74.4	14.0	88.4
	1991–1995	41.2	44.7	85.9	10.9	96.8
Georgia, 1999	1995–2000	25.3	16.2	41.6	3.9	45.3
	1990–1994	24.7	15.2	39.9	4.8	44.5
Central Asia						
Kazakhstan, 1999	1994–1999	33.6	28.3	61.9	10.1	71.4
	1989–1994	24.6	25.1	49.7	7.4	56.7
	1984–1989	29.3	25.6	54.9	11.9	66.1
Kyrgyz Rep., 1997	1992–1997	31.6	29.7	61.3	11.7	72.3
	1987–1992	34.6	36.2	70.8	9.0	79.2
	1982–1987	26.8	55.2	82.0	18.5	99.0
Turkmenistan, 2000	1996–2000	33.8	40.1	73.9	22.0	94.3
	1991–1995	32.1	37.4	69.5	14.2	82.7
	1986–1990	26.9	56.8	83.7	17.6	99.8
Uzbekistan, 1996	1991–1996	22.8	26.3	49.1	10.7	59.3
	1986–1991	20.6	17.2	37.8	13.8	51.1
	1981–1986	21.7	24.6	46.3	19.9	65.3

* See footnote 6 on page 176.
† Neonatal, postneonatal, infant and under-5 mortality rates are per 1,000 live births. Child mortality rates are per 1,000 children surviving to age 1.

Figure 13.7 also shows the 95% confidence interval associated with each estimated rate for these four countries. The point to be made is that there is considerable overlap between the confidence intervals for each series of estimates. Certainly, surveys are useful for measuring large declines in mortality rates which occur over long time periods. However, their usefulness for the purpose of monitoring the overall impact of health programs or to signal the need for health interventions depends on their ability to detect more modest changes in mortality levels over short time periods. The results shown in Figure 13.7 are not encouraging in this respect as there is overlap between the confidence intervals of the series of rates for each country.

The sampling error associated with infant mortality estimates based on survey data depends on the survey design–primarily the sample size and the number of sample clusters. If surveys are to be used to monitor mortality trends in Eastern Europe and Eurasia in the future, larger samples of women will be needed than was the case in the surveys considered here. There are creative ways in which this can be achieved while avoiding unacceptable increases in survey costs. For example, to obtain larger numbers of births on which to based mortality estimates, it is only necessary to administer the pregnancy history section of the questionnaire, rather than the entire questionnaire, to a larger number of respondents. Of course, greater care must be taken to ensure the accuracy and completeness of data collection when increasing sample size and the complexity of survey design. Sacrificing data quality in the effort to reduce sampling error is a poor trade-off.

Figure 13.7
Survey Estimates of Infant with 95% Confidence Intervals*
Eastern Europe and Eurasia: A Comparative Report



* Infant Mortality Rates are per 1,000 live births.
† Infant mortality rates for Azerbaijan prior to 1991 are not available from the survey data.

13.8 Summary of Findings

The surveys collected data using the WHO recommended definition of live birth; a pregnancy outcome which shows any sign of life (i.e., breathing, beating of the heart, or movement of voluntary muscles). The definition of live birth used in all of the surveyed countries at the time of the surveys, with the exception of Armenia, excludes preterm deliveries (i.e., pregnancy outcomes of less then 28 weeks gestation or weighing less than 1,000 grams or less than 35 centimeters in length) from the live birth category unless the child survives for 7 days. The result is that fewer births with a high risk of mortality are classified as live births in these countries and rates of early neonatal mortality are less than would be the case if the WHO definition were used. However, rates specific for ages subsequent to the early neonatal period should not be affected by these definitional issues.

- Survey estimates of childhood mortality were computed for the 5-year period preceding each survey. The mortality estimates apply to the mid- or late 1990s. Infant mortality estimates were lowest for Romania and Armenia (32 and 36 deaths per 1,000 live births), higher for Georgia and Uzbekistan (42 and 49 per 1,000) and substantially higher for Azerbaijan, Kazakhstan, the Kyrgyz Republic, and Turkmenistan (74, 62, 61, and 74 per 1,000).

- Based on survey data, infant mortality rates were calculated by respondent characteristics. As expected, mortality differentials by education were substantialSin five of the eight surveys infant mortality estimates were 60% higher for births to women with a primary or secondary education than to women with a postsecondary education.

- Infant mortality rates were between 30% and 50% greater in rural than in urban areas in Armenia, Kazakhstan, the Kyrgyz Republic, and Turkmenistan. However, in Romania the rural rate was less than the urban rate and, in Azerbaijan, Georgia, and Uzbekistan, rural rates were less than 10% higher than urban rates. Although subject to various interpretations, the observed differentials in the latter countries are suspect. The fact that antenatal care and delivery care are less accessible and less adequate in rural areas suggests the possibility of underreporting of infant deaths in the rural areas in the Romania, Azerbaijan, Georgia, and Uzbekistan surveys.

- The most significant infant mortality differentials were associated with the preceding birth interval. The excess mortality of a short birth interval (less than 24 months compared to 24-47 months) was 40% or more in Georgia, Turkmenistan, and Uzbekistan and 80% or more in Romania, Kazakhstan, and the Kyrgyz Republic. In these countries, approximately one-third of all births of order two and higher occur within 24 months of a previous birth. This indicates a continuing need for education programs which promote better birth spacing and for the availability of reliable, temporary methods of contraception.

- Infant mortality estimates from the surveys were compared with government rates for comparable time periods. The survey estimates were higher than the government rates by more than 50% for Romania, Georgia, and Uzbekistan and were more than twice as high for Armenia, Kazakhstan, the Kyrgyz Republic, and Turkmenistan. The survey estimate of infant mortality for Azerbaijan was four times the government rate.

- Higher infant mortality rates from the surveys do not necessarily mean that the government rates are erroneous, given that they are based on a different definition of live birth. That issue was investigated by considering the contribution to the infant mortality differences of two subintervals of infancy: mortality rates for under 7 days and mortality rates for day 7 to 1 year of age. For the three countries investigated (Armenia, Georgia,and Kazakhstan), between 59%and 65% of the difference was attributable to the interval from day 7 to 1 year of age (i.e., the age interval where mortality rates are unaffected by differences in the definition of live birth). The conclusion is that the registration systems on which the government rates are based suffer significant defects independent of definitional issues.

- Armenia adopted the WHO definition of live birth in 1995. A review of the series of government infant mortality rates for calendar years 1995 through 2000 revealed virtually no increase in the rates. The government infant mortality rate for calendar year 2000 (16 deaths per 1,000 live births) was well below the survey estimate for 1996-2000 (36 per 1,000). The significant conclusion is that, while it would be advantageous for Armenia and the other countries of the region to adopt the WHO definition of live birth, that alone will not correct the underreporting of infant deaths in the civil registration systems.

- Based on survey data, infant mortality trends were examined. In four countries (Romania, Georgia, Kazakhstan, and Uzbekistan), the series of estimates showed no consistent trend. In the remaining four countries (Armenia, Azerbaijan, the Kyrgyz Republic, and Turkmenistan), a recent decline in mortality was indicated. The declining trend was sharpest in the Kyrgyz Republic where infant mortality declined from 82 deaths per 1,000 live births (1982-1997) to 61 per 1,000 (1992-1997). This is persuasive evidence of a mortality decline. Nevertheless, even in this case the 95% confidence interval of the estimates overlapped, which suggests the possibility that the observed trend in the rates could be due to sampling error.

- In the surveyed countries, there is clear evidence that government infant mortality rates are unreliable and that population-based surveys may be the best means of monitoring infant mortality over the next decade and perhaps longer. The broad confidence intervals associated with the survey mortality rates presented in the chapter imply that future surveys should employ larger sample sizes. Of course, when conducting larger surveys, great care must be exercised to maintain data quality. Sacrificing data quality in the effort to reduce sampling error would be a poor trade-off.

Appendix

The Reproductive Section of the Survey Questionnaires

The infant and child mortality data were collected in the Reproductive Section of the Women's Questionnaire following a standard procedure. There were two phases to the collection of the data. First, information was collected in terms of the aggregate number of live births, abortions, miscarriages and stillbirths that the respondent has had and then in terms of a pregnancy history (specific information about each event).

One of the purposes of collecting information on the aggregate number of reproductive events was to inform the respondent about the events she was to report in the event-by event pregnancy history. A series of nine questions were asked. To obtain information on live births, the respondent was asked the number of her sons and daughters living with her, the number of sons and daughters living elsewhere and the number of sons and daughters that have died. If the respondent did not report any deceased children, a probing question is asked: "Have you ever given birth to a boy or girl who cried or showed any signs of life but survived only a few hours or days?" Questions are then asked about the number miscarriages, the number of abortions and the number of stillbirths.

The intent of asking the probing question about deceased children was to obtain information about live births and infant deaths in terms of definitions recommended by the World Health Organization (WHO, 1993).

Following the collection of the aggregate data, an event-by-event pregnancy history was asked. For each live birth reported in the pregnancy history, information was collected on the date of birth (month and year), sex, survivorship, and current age (for surviving children) or age at death (for deceased children). Data on age at death was recorded in either days, months, or years; in days (for children dying under 1 month of age), in months (for children dying after the first month of life but before 2 years of age) and in years (for children dying at 2 years of age or older). These data allow the direct calculation of period-specific morality estimates for various age intervals of infancy and childhood.